

We claim:

1. An electrophotographic color printing machine for producing color images, comprising:

- 5 means for recording an image on an imaging member;
- a first developer unit for developing said image, said first developer unit including a sump for storing a quantity of developer material comprised of toner of a first color and carrier material, a member for transporting developer material from said sump, said sump including a viewing
- 10 window, in communication with developer material, in said sump, an optical sensor, device for measuring reflected light off said viewing window and developer material, and means for generating a signal indicative of the toner concentration in said sump, said optical sensor including a light source and a light detector, said light source emitting light at a first predefine wavelength
- 15 based upon said toner of said first color; and
- a second developer unit for developing said image, said second developer unit including a sump for storing a quantity of developer material comprised of toner of a second color and carrier material, a member for transporting developer material from said sump, said sump including a viewing
- 20 window, in communication with developer material, in said sump, an optical sensor, device for measuring reflected light off said viewing window and developer material, and means for generating a signal indicative of the toner concentration in said sump, said optical sensor including a light source and a light detector, said light source emitting light at a second predefine wavelength
- 25 base upon said toner of said second color.

2. The electrophotographic color printing machine of claim 1, wherein said first color and second color are selected from the group consisting of cyan, magenta, yellow, black, and custom colors.

3. The electrophotographic color printing machine of claim 2, wherein said first predefined wavelength is between 400 and 500 nm or 750 and 850 nm when said first color is cyan.

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4. The electrophotographic color printing machine of claim 2, wherein said first predefined wavelength is between 500 and 800 nm when said first color is yellow.

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5. The electrophotographic color printing machine of claim 2, wherein said first predefined wavelength is between 600 and 800 when said first color is magenta.

6. The electrophotographic color printing machine of claim 2, wherein said first predefined wavelength is between 800 and 1000 nm when said first color is black.

7. The electrophotographic color printing machine of claim 1, wherein said source comprises a LED and said light detector comprises a Si photodiode.

8. The electrophotographic color printing machine of claim 7, further comprising a toner concentration controller includes means for correlating measurements from said optical sensor to a toner concentration measurement.

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9. The electrophotographic color printing machine of claim 8, wherein said toner concentration controller determines said toner concentration measurement based upon the following equation:

$$\%TC_i = C_i \times \int_{\lambda_o}^{\lambda_1} R_{PD} E_i R_i d\lambda$$

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Where

i = C, M, Y, K

RPD is the normalized spectral responsivity of the photodiode.

E_i is the normalized spectral density of the i LED.

C_i is a constant containing (a) optical path factors, (b) peak
10 responsivity of the photodiode, (c) peak responsivity of the LED, and (d)
conversion factor from reflectivity to %TC.

10. The electrophotographic color printing machine of claim 8, wherein said toner concentration controller determines said toner
15 concentration measurement based upon the following equation:

$$\%TC = K_i \times V_i$$

Where

K_i is a constant containing all the parameters for the particular
colored developer and LED set, and V_i is the voltage reading from the
20 photodiode.

11. The electrophotographic color printing machine of claim 8, wherein said toner concentration controller adapted to receive a signal from
said sensor and to generate an "Add Toner" signal to replenish toner in said
25 sump to maintain a predefined toner concentration.

12. The electrophotographic color printing machine according to claim 1, wherein said viewing window comprises a glass window.

13. A method for determining toner concentration of a sample
5 comprised of toner and developer, comprising:

exposing the sample to light; said exposing includes emitting light at a predefined wavelength based upon the color of said toner;

detecting the light reflected off the sample with an optical sensor;
and

10 determining the toner concentration of the sample based upon the light reflected off the sample.

14. The method of claim 13, wherein said exposing includes selecting the predefined wavelength between 400 and 500 nm or 750 and 850
15 nm when said color is cyan.

15. The method of claim 13, wherein said exposing includes selecting the predefined wavelength is between 500 and 800 nm when said color is yellow.

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16. The method of claim 13, wherein said exposing includes selecting the predefined wavelength is between 600 and 800 when said color is magenta.

25 17. The method of claim 13, wherein said exposing includes selecting the predefined wavelength is between 800 and 1000 nm when said color is black.

18. The method of claim 13, wherein said optical sensor comprises a LED and a light detector includes a Si photodiode.

19. The method of claim 18, wherein said determining comprising correlating measurements from said optical sensor to a toner concentration measurement.

20. The method of claim 19, wherein said correlating includes calculating the toner concentration measurement based upon the following equation:

$$\%TC_i = C_i \times \int_{\lambda_o}^{\lambda_1} R_{PD} E_i R_i d\lambda$$

Where

i = C, M, Y, K

RPD is the normalized spectral responsivity of the photodiode.

Ei is the normalized spectral density of the i LED.

Ci is a constant containing (a) optical path factors, (b) peak responsivity of the photodiode, (c) peak responsivity of the LED, and (d) conversion factor from reflectivity to %TC.

21. The method of claim 19, wherein said correlating includes calculating the toner concentration measurement based upon the following equation:

$$\%TC = K_i \times V_i$$

Where

Ki is a constant containing all the parameters for the particular colored developer and LED set, and Vi is the voltage reading from the photodiode.